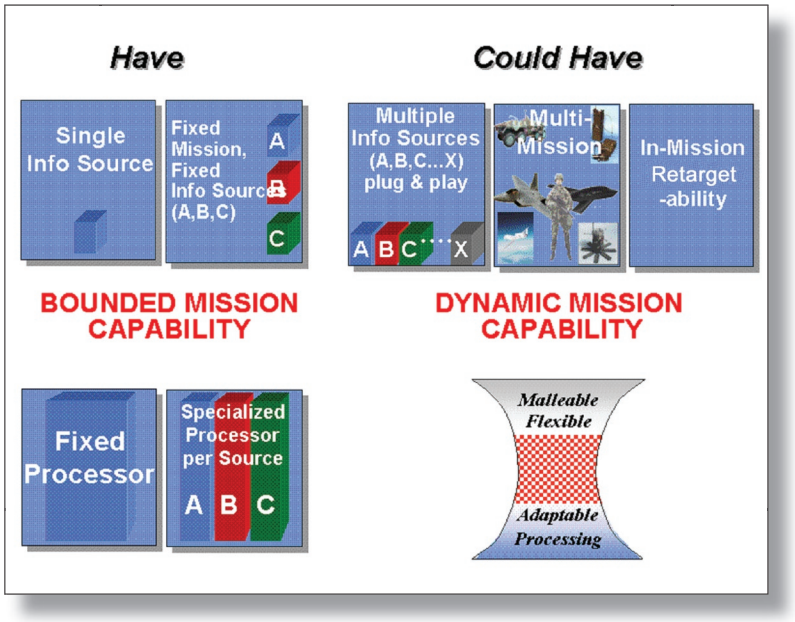
# Air Force Research Laboratory|AFRL

*Science and Technology for Tomorrow's Air and Space Force*

## *Success Story*

## POLYMORPHIC COMPUTING ARCHITECTURES




Today's embedded computing systems, developed for fixed mission scenarios, cannot provide the robust embedded processing capability necessary to fully support retargetable and multi-mission systems. This lack of versatility to dynamic mission requirements and the reduced performance or poorly matched processing performance result in degraded capabilities for our fighting forces and can dramatically limit the military's ability to effectively project forces around the world.

Polymorphic Computing Architectures (PCA) will institute a paradigm shift from static-open-loop to reactive-closed-loop mission algorithms, application software, and hardware implementation. The processing capability is mission and technology invariant yet highly optimizable for each specific in-mission and multi-mission and/or technology instantiation, providing for tactical and strategic tempo opportunities as well as technical upgradability.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Wright-Patterson AFB OH

## Accomplishment

The Information Directorate's PCA program is developing a family of novel malleable microarchitecture processing elements including computer cores, caches, memory structures, data paths, network interfaces, network fabrics with incremental instructions, operating systems (OS), and network protocols. These elements will have the ability to reconfigure to match changing mission and scenario demands.

To support the use of polymorphous computing systems, directorate researchers are creating a model-based software framework for reactive monitoring, optimization, modeling, resource negotiation and allocation, regeneration, and verification. Specific PCA goals allow post-silicon optimization through the incorporation of polymorphous concepts within commercial processing research and development, and fabrication infrastructure.

Other goals include developing an environment that provides resource allocation, negotiation, and monitoring; implementing verification and validation at multiple system levels; developing test beds and conducting proof-of-concept experiments; facilitating technology transitions using strategic teaming; and establishing benchmark and standards groups to create community standards that enable broad application and commercial support of polymorphic computing architectures. The PCA program is concentrating on four critical research areas: Polymorphic System Characteristics, Scenarios, Constraint Metrics, and Abstraction Test Suites; Polymorphous Computing Research; Proof-of-Concepts Experimental Test beds; and Morphware Stable Interfaces.

## Background

The PCA program is a 5-year Defense Advanced Research Projects Agency-sponsored program. Phase 1 is pursuing the identification of high-value dynamic embedded computing mission characteristics, application functionality, initial polymorphous computing concepts and implementations, and early concept experimentation and prototyping. Phase 2 research will investigate innovative approaches and techniques leading to or enabling revolutionary advances in the state of the art.

Polymorphic architectures break the current failure-prone development approach of hardware first and software last by moving beyond conventional silicon to flexible polymorphous computing systems. This is possible through the development of a family of novel malleable microarchitecture processing elements including computer cores, caches, memory structures, data paths, network interfaces, network fabrics with incremental instructions, OS, and network protocols.

Information
Emerging Technologies

## Additional information

To receive more information about this or other activities in the Air Force Research Laboratory, contact TECH CONNECT, AFRL/XPTC, (800) 203-6451 and you will be directed to the appropriate laboratory expert. (03-IF-09)